REMARKS

The invention for which protection is sought in this application is based on the discovery that shield gas delivery elastomer hoses recommended for GTAW welding (and inert shielded gas welding in general) are capable of permitting permeation of significant gaseous moisture through the hose wall material on a molecular level despite every precaution taken by the welder to avoid introduction of moisture into the weld zone.

As stated in the specification, after careful experimentation by the inventor, it was learned that plastic, rubber and other elastomer hose materials available for welding gas supply applications are subject to various degrees of gas permeation or diffusion through the wall of the hoses, depending on the material used in the hoses and other factors. (Specification, page 5, first full paragraph.)

Permeation of moisture through the wall of elastomer hose materials, it was theorized, resulted in a condition that had an unusual effect on the basic welding process recited in the claims in this application, namely the process recited in the preamble of each independent claim.

As claimed, this welding process involves the use of hydrogen and an inert gas while welding non-stainless steel metal work pieces (i.e., carbon steel) in a first root pass, and then doing a second pass without hydrogen over the root pass to essentially remove any residual hydrogen remaining in the root pass. (It is well-known that residual hydrogen present in carbon steel weldments may have an adverse effect on the strength and quality of the weld.)

In such a weld process, the presence of even the minutest quantity of hydrogen in the form of moisture after the first root pass seemed to create a condition whereby expulsive eruptions of fused metal disrupted the second pass of the welding process.

Every skilled welder knows that in an inert gas welding process moisture in the weld zone is to be avoided, although such need to avoid moisture varies with different welding procedures and environments. It is well-known that welding can be carried out under water, for example, where the presence of moisture must be assumed.

On the other hand, while the distinction may appear to be subtle, the degree to which moisture must be avoided in an inert gas arc welding procedure has not been appreciated and in particular the context of a welding process of the kind recited in the preamble of the independent claims of this application.

As explained in the application, in accordance with knowledge of a skilled welder, the shield gas storage tanks, the fittings, the delivery hoses and the welding heads used for the supply and delivery of the shield gas mixture were all examined in detail by the inventor as possible sources of contaminating moisture and oxygen. (See paragraph spanning pages 4 and 5.) Still, the source of moisture eluded discovery despite the inventor's best efforts to locate such possible source.

All the hoses that were used met all specifications for GTAW welding (Page 5, first full paragraph). Yet, it required extensive experimentation by the inventor to discover that the possible source of moisture in the cell pockets of the weld that was expulsively reacting during the second weld pass could be gaseous moisture vapor from atmospheric moisture permeating or diffusing through the material of the hose walls to a sufficient degree to enter the shield gas stream and to become entrapped in the form of cells or pockets of the first root pass weld (see page 5, first full paragraph).

It was then theorized that, upon heating during the subsequent weld pass, the moisture in the cells was superheated and created the violent expulsion effects observed. This phenomenon was observed repeatedly during continued experimentation in the absence of the inventive solution discovered by the inventor.

In accordance with known principles of physics, gaseous moisture vapor can permeate a membrane "uphill", that is, even though the total gas pressure on the side of the membrane towards which the gas permeates is higher than the total gas pressure measured on the opposite side of the membrane, moisture partial pressures will seek a balance on both sides of the membrane, regardless of the apparent total observed gas pressure differential. In the context of this invention, it was further theorized that, despite the fact that the pressure inside the gas delivery hoses was higher than atmosphere, nevertheless because of the principle of balancing of gas partial pressures, the gaseous moisture tended to be driven through the walls of the gas

delivery hoses on a molecular level because the moisture partial pressure outside the hose was higher than the moisture partial pressure inside the hose. Because of the small size of the hydrogen molecule, permeation of moisture through the otherwise "moisture-resistant" elastomer hose wall resulting from the moisture seeking to balance the partial pressure inside and outside the hose wall permitted sufficient moisture to enter the shield gas stream to adversely affect the weld. (See paragraph spanning pages 13 and 14.)

In short, this surprising discovery made by the inventor simply would not occur intuitively to a welder of ordinary skill in the art, namely that diffusion of minute quantities of gaseous moisture through an otherwise elastomer moisture-free shield gas delivery system could adversely affect a non-stainless steel weld process wherein hydrogen and an inert gas are employed during a first root pass and a subsequent hydrogen-free weld pass is laid over the first root weld.

As described in the specification and recited in the claims of this application, this discovery led to a search for weld gas hose materials having very low rates of moisture infusion ("permeability coefficient") with the consequent result that selection of appropriate hose materials eliminated the problem of gaseous moisture permeation and contamination of the first weld pass with moisture in the weld cells. (See page 14, third full paragraph.) In accordance with the claims of this application, the invention lies in utilizing, in a process of buttwelding non-stainless steel metal workpieces in accordance with the process described in U.S. Patent No. 5,686,002, the use of a shield gas delivery system that prevents infusion of moisture by permeation of the moisture via the delivery elastomer hose system. In accordance with the dictionary meaning of "permeation", the undesired moisture thus blocked is gaseous moisture that would otherwise pass through the pores or interstices of the hose material.

It is respectfully submitted that none of the prior art of record in this application is remotely concerned with preventing substantial permeation of gaseous moisture into the shield gas via a gas delivery elastomer hose system in conjunction with a welding process of the kind recited in the preamble of each independent claim. The invention lies in this unique combination and it is respectfully submitted that the inventor is

entitled to protection for this valuable contribution to welding technology.

The specification has been amended on page 14 to correct an inadvertent omission of the parentheses as shown in the amended version of the formula. The formula is well-known and no new matter has been introduced by this amendment.

Claim 1 has been amended for the sake of consistency. The first line of the last paragraph states that the root pass "is carried out in the substantial absence of moisture ...." It is desired to make the rest of the paragraph consistent with this statement by indicating that the shield gas delivery elastomer hose system substantially prevents permeation of moisture into the shield gas so that it is consistent with the earlier statement. By the term "substantially" is meant that a degree of permeation that would adversely affect the weld process due to the presence of moisture permeating through the elastomer hose is prevented. Ideally, zero permeability is desired. In the real world, on the other hand, a low degree of permeation likely could be tolerated so long as it would not adversely affect the claimed weld process, that is, result in the moisture entrapment causing the expulsion effect.

With regard to the rejection stated in the Office Action, claims 1-4 and 9-7 stand rejected as unpatentable over Flood taken with the Lyman excerpt on grounds of obviousness (35 U.S.C. 103(a)). The examiner relies on Lyman as a teaching (page 124) that it is known that "...even the slightest deposit of water in the line will contaminate the inert atmosphere...". The article also recommends plastic hoses to be used for gas lines, as acknowledged by the examiner.

It is acknowledged that the deposit of water in a gas delivery line obviously would contaminate a weld with moisture. What is not known is that permeation of gaseous moisture vapor on a molecular level through the pores of the plastic or elastomer hoses as the moisture attempts to achieve a balance of partial pressures could lead to an adverse effect in a specific welding procedure. The cited 1971 edition of *Metals Handbook* contains no reference to moisture permeation through the walls of inert gas elastomer delivery hoses nor does it even recognize or suggest that such a phenomena could occur at all, much less adversely affect a welding procedure.

It is respectfully submitted that the language in each claim of this application

referring to the avoidance of permeation of moisture into the shield gas via the delivery elastomer hose system patentably distinguishes the inventive concept over the prior art relied on by the examiner. Further, it is respectfully submitted that the examiner's rejection does not establish a *prima facie* case of obviousness with regard to the claimed subject matter in this application as it fails to address the claim limitations regarding the use of a gas delivery elastomer hose that substantially prevents permeation of moisture into the shield gas.

To an even greater extent, the examiner has not established a *prima facie* case of obviousness with regard to claims 2, 3 and 4 that recite the process using a gas delivery elastomer hose that has a specific moisture permeability coefficient as recited in the claims, or a hose made of a particular material known to have a very low moisture permeability coefficient. It is respectfully submitted that it is incumbent on the examiner to at least establish a *prima facie* case of obviousness with regard to these claims as well. Thus, the examiner must establish a *prima facie* case of obviousness with regard to all of the claims in the application that specifically recite the use of a shield gas delivery elastomer hoses that substantially prevent permeation of moisture into the shield gas and more particularly the claims that recite a specific moisture permeability coefficient within the range of 0 to 275 (claims 2-6 and 9-18).

With regard to the novelty and non-obviousness of claims 7 and 8, which recite the use of a welding electrode composition in combination with the welding process described in the preamble of the claims, it is respectfully submitted again that the examiner must establish a *prima facie* case of obviousness with regard to the claimed subject matter.

In rejecting claims 7 and 8 on grounds that they recite obvious subject matter, the examiner relies on the fact that such welding electrodes as recited were known at the time of the invention. What the examiner appears to overlook is the fact that, while such electrode compositions were known, no one other than the inventor discovered that the use of such welding electrode compositions could have a beneficial effect with regard to the inventive process recited in the preamble of the claims. The recited invention lies in the discovery that such electrode compositions have a beneficial effect

in a specific welding process, such discovery having been arrived at through laborious experimentation on the part of the inventor. In short, the inventor made a discovery through experimentation that a particular composition of electrode resulted in an extended electrode life while carrying out the process recited in the preamble to the claim. This specific discovery is entitled to protection and there is no basis in the prior art or general knowledge for concluding that the selection of the recited welding electrode compositions out of the entire population of commercially available electrodes would have been obvious to a person of ordinary skill in the art. Indeed, there are at least a dozen non-consumable electrode compositions available to a welder. There is no evidence to establish that it would be obvious to such a welder when carrying out a process in accordance with the preamble of the claims to use a specific composition of electrode to obtain an extended life of the electrode as compared with other welding electrode compositions in the specific claimed welding process. It is thus respectfully submitted that a process using the recited electrodes is inventive and non-obvious in the context of the specific welding process recited in the claims.

It is respectfully submitted that withdrawal of the rejection is warranted and the same is respectfully requested.

Respectfully submitted,
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